

## DESCRIPTION

## FLOOR SURFACE FINISHING DEVICE

## 5 TECHNICAL FIELD

[0001]

This invention relates to a floor surface finishing device which is used in a construction site for a final finishing operation on a surface of a concrete or mortar floor after casting.

10

## BACKGROUND ART

[0002]

When constructing a floor surface with concrete or mortar, conventionally, ready-mixed concrete cast in a construction area is leveled to form a floor and left for several hours. Then, the surface of the floor is evenly pressed using a plane leveling machine called a trowel to form a flat surface, followed by a manual operation of a skilled worker with a finishing iron (a square iron) for a final finishing.

[0003]

A typical plane leveling machine used in the above-described floor construction is a machine having a rotary blade which rotates like a propeller along with a motor for driving the rotary blade (see Patent Document 1, for example). Normal operating steps are: on a floor surface to be finished after casting of ready-mixed concrete and leveling, the above-mentioned plane leveling machine is placed, and the machine is moved backward and forward and from side to side along the floor surface while rotating a rotary blade with a motor.

[0004]

Patent Document 1: Unexamined Japanese Utility Model Publication No. Hei 5-57198 (pages 2-5, Fig. 1)

## 5 DISCLOSURE OF THE INVENTION

### PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

In a conventional floor finishing operation, after a pressing operation using a plane leveling machine according to the above-described steps, a skilled worker completes the  
10 finishing with a manual operation. This requires considerable work and time to complete a floor construction, and also a worker has to endure a large amount of physical load. During a final finishing step, in particular, a worker almost crawls along a floor surface keeping a low posture with his/her back bending at nearly 90 degrees, and steps backward by about 20 cm per each move while pressing the floor surface with a finishing iron in  
15 his/her hand moving from side to side. Thus, in practice, a great deal of time and work is expended by a skilled worker on the final finishing.

[0006]

In addition, since a final finishing operation must be completed before concrete or mortar cast in an operation site is hardened, if a floor to be constructed is wide, more than  
20 one skilled worker is needed. However, under a current situation where the number of skilled workers is decreasing, it is difficult to employ the necessary number of workers.

[0007]

Furthermore, in a final finishing operation, as a worker has to remain in an unnatural posture over hours, the physical burden on his/her feet, back and/or shoulders is  
25 extremely large. Skilled workers engaging in final finishing operations, who have repeated

such operations over a long period of time, suffer from chronic backache or shoulder ache even after finishing their operations.

[0008]

An object of the present invention is to provide a floor surface finishing device  
5 easy to handle, capable of completing a final finishing operation on a floor surface in a relatively short time, and making it possible to reduce the number of operators.

#### MEANS FOR SOLVING THE PROBLEMS

[0009]

10 A floor surface finishing device according to the present invention comprises a plane leveling machine having a plurality of rotary blades which rotate in a propeller manner by a driving force while keeping in contact with a floor surface to be finished, and a planar finishing blade which is connected to the plane leveling machine and is disposed in a part of outer peripheral regions of planes of rotation of the rotary blades. The finishing  
15 blade is disposed so that at least a part of the finishing blade is brought into contact with the floor surface after the rotary blades have come into contact with and passed over the floor surface.

[0010]

The floor surface finishing device having the above-described structure is placed  
20 on a floor surface to be finished, the rotary blades of the plane leveling machine are rotated by a driving force, and the whole of the floor surface finishing device is moved along the floor surface in a horizontal direction while maintaining the rotary blades preceding the finishing blade. Thus, the floor surface to be finished is leveled with pressure by the rotary blades, thereby completing a final finishing operation with the following finishing blade.  
25 Then, as the finishing blade is disposed so that at least a part of the finishing blade is

brought into contact with the floor surface after the rotary blades have come into contact with and passed over the floor surface, the final finishing operation can be securely completed on the floor surface leveled by the rotary blades with pressure.

[0011]

5           As described above, the floor surface finishing device can conduct both a leveling operation with pressure and a final finishing operation simply by moving the whole device along the floor surface to be finished in a horizontal direction. The device can be handled in an easy manner so that a final finishing operation of a floor surface can be completed in a relatively short time. Furthermore, since both a leveling operation with pressure and a  
10   final finishing operation can be achieved by one operator, the number of operators can be reduced and no skilled workers are needed.

[0012]

          Preferably, the above finishing blade may be slanted to have an angle of attack toward a pivotal center of the rotary blades. The finishing blade arranged in this manner  
15   can be moved forward while maintaining an angle of attack toward a moving direction of the floor surface finishing device, leading to a further improved final finishing.

[0013]

          In this case, preferably, an angle adjusting mechanism may be provided to vary an angle of attack of the finishing blade. With the angle adjusting mechanism, an angle of  
20   attack of the finishing blade can be set depending on each condition of constructing a floor surface. Thus, a suitable final finishing operation can be conducted in accordance with the type, property or curing condition of a floor surface material such as concrete or mortar.

[0014]

          It is also preferable that the above finishing blade may be movable in a direction  
25   including a moving direction along a pivotal center of the rotary blades. By this structure,

the finishing blade can either come into contact with or separate from a floor surface to be finished which is brought into contact with planes of rotation of the rotary blades. In other words, as the finishing blade can come into contact with or separate from a floor surface according to need, the finishing blade can be handled in an easy manner, improving its operability.

[0015]

In addition, preferably, a pressing means may be provided to press the finishing blade against the floor surface to be finished. With this pressing means, pressing force of the finishing blade against the floor surface can be increased, and thus the flattening and finishing efficiency to the floor surface is enhanced, which enables further improvement in the final finishing. Here, provided with a variable pressing force of the pressing means, a suitable final finishing operation can be conducted in accordance with the type, property or curing condition of a floor surface material such as concrete or mortar.

[0016]

In this case, a plumb bob provided as the above pressing means exhibits a secure pressing effect despite its simple mechanism, and the pressing force can be varied simply by adjusting weight of the plumb bob. Accordingly, as in the above-described cases, a suitable final finishing operation can be conducted in accordance with the type, property or curing condition of a floor surface material such as concrete or mortar.

[0017]

It is also preferable that the finishing blade may be rotatable around the rotary blades. By this structure, positional relations between an operator who handles the floor surface finishing device, the rotary blades, and the finishing blade can be varied. Therefore, while maintaining the positional relation in which the rotary blades are firstly brought into contact with a floor surface to be finished before the finishing blade comes into contact with the

floor surface, an operator can move the floor finishing device in a direction to the back of the operator (in a pulling direction) or move the floor finishing device from side to side of the operator. Thus, operability and safety when conducting a finishing operation of a floor surface adjacent to a wall or pillar, or a floor surface with obstacles such as a hole, groove or protruding member, can be further enhanced.

[0018]

Preferably, at least a part of the finishing blade may be formed of a flexible elastic plate. By this structure, when the finishing blade presses a floor surface to be finished, at least a part of the finishing blade bends so as to elastically press the floor surface, enabling tighter contact to the floor surface. Accordingly, the finished effect of a floor surface immediately after and over which the rotary blades have passed is improved, and a final finished surface has an excellent appearance.

[0019]

It is also preferable that the finishing blade may be detachable from the plane leveling machine. By this structure, the finishing blade can be changed depending on conditions of a construction site, and a worn or damaged finishing blade can be replaced. Therefore, an optimal finishing operation is conducted in accordance with each construction site, and maintenance is also easier.

[0020]

As another structure, a seat for an operator may be provided on a part of the plane leveling machine. By this structure, an operator can sit on the seat when conducting a floor finishing operation, which greatly alleviates a physical load of the operator.

#### ADVANTAGE OF THE INVENTION

[0021]

According to the present invention, the following advantages can be obtained.

[0022]

(1) A plane leveling machine having a plurality of rotary blades which rotate in a propeller manner by a driving force while keeping in contact with a floor surface to be finished and a planar finishing blade which is connected to the plane leveling machine and is disposed in a part of outer peripheral regions of planes of rotation of the rotary blades are provided. The finishing blade is disposed so that at least a part of the finishing blade is brought into contact with the floor surface after the rotary blades have come into contact with and passed over the floor surface. Thus, the device can be handled in an easy manner so that a final finishing operation of a floor surface can be completed in a relatively short time. Furthermore, the number of operators including skilled workers can be reduced.

(2) By disposing the finishing blade to be slanted to have an angle of attack toward a pivotal center of the rotary blades, the finishing blade can be moved forward while maintaining an angle of attack toward a moving direction of the floor surface finishing device, leading to a further improved final finishing.

(3) By providing an angle adjusting mechanism to vary an angle of attack of the finishing blade, the angle of attack of the finishing blade can be set depending on each condition of constructing a floor surface. Thus, a suitable final finishing operation can be conducted in accordance with the type, property or curing condition of a floor surface material such as concrete or mortar.

(4) With the finishing blade movable in a direction including a moving direction along a pivotal center of the rotary blades, the finishing blade can come into contact with or separate from a floor surface to be finished according to need, the finishing blade can be handled in an easy manner, improving its operability.

(5) By providing a pressing means to press the finishing blade against a floor

surface to be finished, pressing force of the finishing blade against the floor surface can be increased, and thus the flattening and finishing efficiency to the floor surface is enhanced, which enables further improvement in the final finishing.

(6) With a plumb bob provided as a pressing means, a secure pressing effect despite  
5 its simple mechanism can be obtained, and the pressing force can be varied simply by adjusting weight of the plumb bob. Accordingly, a suitable final finishing operation can be conducted in accordance with the type, property or curing condition of a floor surface material such as concrete or mortar.

(7) With the finishing blade rotatable around the rotary blades, positional relations  
10 between an operator who handles the floor surface finishing device, the rotary blades, and the finishing blade can be varied. Accordingly, the positional relation can be set depending on conditions of a construction site, improving operability and safety.

[0029]

(8) By forming at least a part of the finishing blade with a flexible elastic plate,  
15 finishing effect to a floor surface immediately after the rotary blades have passed is improved, and a final finished surface has an excellent appearance.

[0030]

(9) With the finishing blade detachable from the plane leveling machine, the finishing blade can be changed depending on conditions of a construction site, and a worn  
20 or damaged finishing blade can be replaced. Therefore, an optimal finishing operation is conducted in accordance with each construction site, and maintenance is also easier.

[0031]

(10) By providing a seat for an operator on a part of the plane leveling machine, an operator can sit on the seat when conducting a floor finishing operation, which greatly  
25 alleviates the physical load on the operator.



## BRIEF DESCRIPTION OF THE DRAWINGS

[0032]

5 [Fig. 1] is a side view illustrating a floor surface finishing device which is a first embodiment of the present invention.

[Fig. 2] is a partial plan view of the floor surface finishing device in Fig. 1.

[Fig. 3] is a side view of a finishing blade part constituting the floor surface finishing device in Fig. 1.

[Fig. 4] is a view seen in a direction of an arrow B in Fig. 3.

10 [Fig. 5] is an exploded perspective view illustrating a finishing blade of another embodiment.

[Fig. 6] is a perspective view illustrating a finishing blade of another embodiment.

[Fig. 7] is an exploded perspective view illustrating a finishing blade of another embodiment.

15 [Fig. 8] is an exploded perspective view illustrating a finishing blade and its detaching mechanism of another embodiment.

[Fig. 9] is a side view illustrating a condition of a floor surface finishing operation by the finishing blade in Fig. 8.

20 [Fig. 10] is a side view illustrating a floor surface finishing device which is a second embodiment of the present invention.

[Fig. 11] is a side view illustrating a floor surface finishing device which is a third embodiment of the present invention.

[Fig. 12] is a side view illustrating a floor surface finishing device which is a fourth embodiment of the present invention.

25 [Fig. 13] is a side view illustrating a floor surface finishing device which is a fifth

embodiment of the present invention.

[Fig. 14] is a plan view illustrating the floor surface finishing device in Fig. 13.

[Fig. 15] is a side view illustrating a floor surface finishing device which is a sixth embodiment of the present invention.

5 [Fig. 16] is a side view illustrating a floor surface finishing device which is a seventh embodiment of the present invention.

[Fig. 17] is a side view illustrating a floor surface finishing device which is an eighth embodiment of the present invention.

10 [Fig. 18] is a side view illustrating a floor surface finishing device which is a ninth embodiment of the present invention.

#### EXPLANATION OF REFERENCE NUMERALS

[0033]

	1, 30, 40, 50, 60, 70, 80, 90, 100: floor surface finishing device
15	2, 2a: floor surface to be finished
	3, 63: motor
	4: rotary blade
	5, 165: plane leveling machine
	6, 20a, 20b, 26j, 36, 46: connecting member
20	6a, 36a, 46a, 56a, 62, 88: vertical shaft
	6b: mounting member
	6c: mounting hole
	6d, 56b, 79: horizontal shaft
	6e: supporting member
25	6f, 26f, 36f, 46f, 56f, 65, 74, 83, 96f, 106f: elevating arm

- 6g: mounting pin
- 6h: mounting hole
- 6i, 26i: attaching member
- 7: plane of rotation
- 5      8, 8a, 8b, 8c, 28, 68, 75, 84: finishing blade
- 8d, 92b: mounting member
- 8e, 46b, 46c: auxiliary member
- 9, H: operating handle
- 10: support
- 10      11: hook
- 12, 12a, 12b, 12c, 22: fixing member
- 12d: fixing portion
- 12e, 20d: connecting portion
- 13, 13a, 23: screw
- 15      14: horizontal bar
- 15: plumb bob
- 16, 30a, 30b, 30c, 30d, 40a, 40b, 40c, 40d, 50a, 50b, 50c, 50d, 67, 69, 76, 77, 86,
- 87: pulley
- 17, 37, 47, 57a, 57b, 66, 78, 85, 97a, 107: wire
- 20      18, 31, 41, 51a, 91a: elevating lever
- 19: wire guide
- 19a: guide hole
- 20: link mechanism
- 20a, 20c: link mechanism
- 25      20b: hinge portion

- 20e, 26e, 26k: connecting hole
- 21: shaft body
- 26a: reinforcing member
- 26b, 26c, 26m: tubular body
- 5 36b, 73: tubular member
- 46g, 56g, 56c, 64, 82, 93, 96g, 106g: shaft
- 46i, 81: slanting shaft
- 46h: stopper
- 56d: auxiliary elevating arm
- 10 61: hoist
- 51b, 91b: auxiliary elevating lever
- 92a: angle adjusting lever
- 101: switch
- A, B, D1, D2: arrow
- 15 C: pivotal center
- L: length
- S: seat
- T: thickness
- W: width
- 20  $\theta$  : angle of attack

## BEST MODE FOR CARRYING OUT THE INVENTION

[0034]

With reference to Figs. 1 to 4, a floor surface finishing device which is a first  
 25 embodiment of the present invention will be explained below. As shown in Figs. 1 and 2,

a floor surface finishing device 1 of this embodiment comprises a plane leveling machine 5 having a plurality of rotary blades 4 which rotate in a propeller manner by a driving force of a motor 3 while keeping in contact with a floor surface to be finished 2, and a planar finishing blade 8 which is connected to the plane leveling machine 5 via a connecting member 6 and is disposed in a part of outer peripheral regions of planes of rotation 7 of the rotary blades 4. The plane leveling machine 5 further comprises, on the opposite side of the finishing blade 8, an operating handle 9 for operating the floor surface finishing device 1 by an operator.

[0035]

As shown in Fig. 3, a support 10 having a reversed L-shape stands on a front portion of the motor 3 of the plane leveling machine 5. On each of upper and lower portions of a vertical part of the support 10, an L-shaped hook 11 is fixed. The L-shaped hook 11 is inserted into an mounting hole 6c of an mounting member 6b which is fixed on each of upper and lower portions of a vertical shaft 6a of the connecting member 6 so that the finishing blade 8 is connected to the plane leveling machine 5 via the connecting member 6.

[0036]

The connecting member 6 comprises the above-mentioned vertical shaft 6a, a horizontal shaft 6d horizontally extending from the vertical shaft 6a, a supporting member 6e fixed aslant between the vertical shaft 6a and the horizontal shaft 6d, and an elevating arm 6f of which base end portion is pivotally supported by the supporting member 6e. The base end portion of the elevating arm 6f is pivotally supported in a detachable manner by one of a plurality of mounting holes 6h which are open on the supporting member 6e via a mounting pin 6g. The base end portion of the elevating arm 6f can be selectively attached to one of the plurality of mounting holes 6h. Whichever of the mounting holes 6h is

selected, the elevating arm 6f can be rotatable in upper and lower directions centering around the mounting pin 6g.

[0037]

On a distal end portion of the elevating arm 6f, a fixing member 12 having an L-shaped section is fixed in a horizontal direction so as to form a T-shape with the elevating arm 6f and the fixing member 12 taken in a plan view. The planar finishing blade 8 is attached to the fixing member 12 along a longitudinal direction thereof. The finishing blade 8, which is fixed on a bottom surface of the fixing member 12 with a screw 13, is detachable from the fixing member 12 by loosening the screw 13. Thus, the finishing blade 8 can be replaced by another finishing blade with a different size, thickness or material depending on each construction condition such as a type or property of a floor surface to be finished. If a thumbscrew is used instead of the screw 13, the finishing blade can be detached without using tools such as a wrench.

[0038]

Above a connecting portion of the elevating arm 6f and the fixing member 12, a horizontal bar 14 is provided in parallel to the fixing member 12. Two plumb bobs 15 are attached to the horizontal bar 14 at symmetrical positions on both sides of the connecting portion. On a rear side of the connecting portion of the elevating arm 6f, a rotatable pulley 16 is disposed. A wire 17, of which distal end portion is mounted on the horizontal shaft 6d, is hung on the pulley 16 to form a U-turn shape. A base end portion of the wire 17 passes through a guide hole 19a of a wire guide 19 on a distal end portion of the horizontal shaft 6d and is mounted to an elevating lever 18 of the operating handle 9.

[0039]

In a state where the connecting member 6 is being connected to the support 10, as shown in Fig. 2, the connecting member 6 is rotatable centering around the hook 11 in a

horizontal direction. Therefore, by rotating the connecting member 6 as well as the finishing blade 8 depending on operating conditions, an operator manipulating the operating handle 9 can also conduct a finishing operation with the finishing blade 8 placed either of a right or left side of the rotary blades 4 from the operator's viewpoint. If a distal end portion of a wire is mounted to an end portion of the horizontal bar 14 which supports the plumb bob 15 of the finishing blade 8, for example, and a base end portion of the wire is extended up to an operating handle, the finishing blade 8 can be rotated in a horizontal direction by tensing and loosening the wire.

[0040]

Here, a use of the floor surface finishing device 1 is explained below. As shown in Fig. 1, the floor surface finishing device 1 is carried into a construction site and placed on the floor surface to be finished 2. The motor 3 is started to rotate the rotary blades 4 of the plane leveling machine 5. An operator pulls the operating handle 9 so that the whole of the floor surface finishing device 1 horizontally moves along the floor surface to be finished 2 toward a direction of an arrow A while the rotary blades 4 keep preceding the finishing blade 8.

[0041]

By the above operation conducted by an operator, the floor surface to be finished 2 is leveled with pressure by the rotary blades 8, followed by a final finishing by the finishing blade 8. At this time, the finishing blade 4 is arranged so that an area close to one of the longitudinal sides of the finishing blade 8 is brought into contact with a floor surface to be finished 2a immediately after the rotary blades 4 have come into contact with and passed over the floor surface to be finished 2a. Accordingly, the floor surface to be finished 2a leveled with pressure by the rotary blades 4 can be subject to a final finishing.

[0042]

As described above, the floor surface finishing device 1 can level a floor surface with pressure and conduct a final finishing simply by rotating the rotary blades 4 with the motor 3 and horizontally moving the whole of the floor surface finishing device 1 to the direction of the arrow A along the floor surface to be finished 2 utilizing the rotary movement of the rotary blades 4. Therefore, the device is easy to handle and can complete a final finishing operation of the floor surface to be finished 2 in a relatively short time. Moreover, only one operator is necessary to manipulate the floor surface finishing device 1 to conduct both a leveling operation with pressure and a final finishing operation, which reduces the number of operators and does not need skilled workers.

[0043]

Here, the finishing blade 8 is tilted so as to have an angle of attack  $\theta$  toward a pivotal center C of the rotary blades 4. Therefore, the finishing blade 8 can move forward while maintaining the angle of attack  $\theta$  toward a moving direction of the floor surface finishing device 1. Thus, the floor surface finally finished by the finishing blade 8 has an excellent appearance.

[0044]

In addition, as an angle adjusting mechanism to vary the angle of attack  $\theta$  of the finishing blade 8, provided are the supporting member 6e having the plurality of mounting holes 6h and the elevating arm 6f which can be pivotally supported by one of the mounting holes 6h selectively. Accordingly, if the base end portion of the elevating arm 6f is pivotally supported by the mounting holes 6h located on an upper side and close to the horizontal shaft 6d, the angle of attack  $\theta$  of the finishing blade 8 becomes larger. On the other hand, if the base end portion of the elevating arm 6f is supported by the mounting holes 6h located on a lower side and close to the vertical shaft 6a, the angle of attack  $\theta$  of the finishing blade 8 becomes smaller.



[0045]

With the angle adjusting mechanism described above, the angle of attack  $\theta$  of the finishing blade 8 can be set depending on construction conditions of the floor surface to be finished 2, and thus a suitable final finishing operation can be conducted in accordance with the type, property or curing condition of a floor surface material such as concrete or mortar.

[0046]

By tilting the elevating lever 18 provided on the operating handle 9, the elevating arm 6f moves up and down centering around the mounting pin 6g via the wire 17, thereby moving the finishing blade 8 in upper and lower directions (a direction parallel to the pivotal center C of the rotary blades 4). Thus, the finishing blade 8 can be brought into contact with or separate from the floor surface to be finished 2 which comes into contact with the planes of rotation 7 of the rotary blades 4. Namely, by tilting the elevating lever 18 according to need, the finishing blade 8 can either come into contact with or separate from the floor surface to be finished 2, thereby realizing easier handling and enhancing operability.

[0047]

Furthermore, the plumb bob 15 for pressing the finishing blade 8 against the floor surface to be finished 2 increases pressing force of the finishing blade 8 onto the floor surface to be finished 2. Therefore, an excellent finishing effect on the floor surface 2 can be obtained to improve the condition after final finishing. In addition, since the plumb bob 15 can be detached from the horizontal bar 14, the weight of the plumb bob 15 can be changed by varying the volume, number or material thereof. A suitable final finishing operation can be conducted in this manner in accordance with the type, property or curing condition of a floor surface material such as concrete or mortar.

[0048]

As described above, the finishing blade 8, which is horizontally rotatable centering around the hook 11, can be horizontally rotated around the rotary blades 4 and held at an optional position. Therefore, it is possible to change a positional relation between an operator (not shown) standing near an end portion of the operating handle 9 to manipulate the floor surface finishing device 1, the rotary blades 4, and the finishing blade 8. Thus, in addition to a basic use for conducting a floor finishing operation shown in Fig. 1 in which an operator (not shown) moves the floor surface finishing device 1 by pulling it in the direction of the arrow A, a floor surface finishing operation can also be conducted with the finishing blade 8 disposed on either right or left side of the rotary blades 8 as shown in Fig.

2.

[0049]

Specifically, as shown in Fig. 2, the whole of the floor surface finishing device 1 can be moved in a direction of an arrow D1 with the finishing blade 8 disposed on a right side of the rotary blades 4 seen from the operating handle 9 (a bottom side on the paper of Fig. 2). Alternatively, the whole of the floor surface finishing device 1 can be moved in a direction of an arrow D2 with the finishing blade 8 disposed on a left side of the rotary blades 4 (a top side on the paper of Fig. 2). In either method of use, a floor surface finishing operation can be conducted while maintaining a positional relation in which the finishing blade 8 is brought into contact with the floor surface 2a after the rotary blades 4 have come into contact with and passed over the floor surface 2a. Therefore, when finishing a floor surface adjacent to a wall or pillar, or a floor surface with obstacles such as a hole, groove or protruding member, the moving direction of the floor surface finishing device 1 can be set depending on conditions of the construction sites, which improves operability. A danger of encountering the above obstacles for an operator moving backward in the state shown in Fig. 1 can be avoided by employing the operating methods

to move the device in the direction of the arrow D1 or D2, leading to a safer operation.

[0050]

The rotary blades 4 rotate clockwise in a plan view (a state shown in Fig. 2). Therefore, the plane leveling machine 5 has a character of moving in the direction of the arrow D1 by lifting up the operating handle 9 (moving away from the floor surface) whereas the plane leveling machine 5 has a character of moving in the direction of the arrow D2 by lowering the operating handle (moving toward the floor surface). Accordingly, when the finishing blade 8 is disposed on either right or left side of the rotary blades 4, an operation is efficiently conducted by utilizing this character in the movement of the plane leveling machine 5.

[0051]

In this embodiment, the finishing blade 8 is formed of a flexible elastic plate (a stainless steel plate or a special steel plate having a thickness  $T$  of 0.3 to 0.7 mm, a width  $W$  of 50 mm to 250 mm, and a length  $L$  of 700 mm to 3000 mm, for example). This enables tighter contact to the floor surface to be finished 2a immediately after the rotary blades 4 have passed, and a final condition after finishing is excellent in its appearance.

[0052]

The length  $L$  of the finishing blade 8 is larger than a diameter of the plane of rotation 7 of the rotary blades 4, and a direction along the length  $L$  of the finishing blade 8 is arranged in parallel to a tangential direction of an outer periphery of the plane of rotation 7. In this manner, after the rotary blades 4 have come into contact with and passed over the floor surface to be finished 2a, the finishing blade 8 is always brought into contact with and passes over the floor surfaces to be finished 2 to complete a final finishing, which secures a final finishing operation. The use of the floor surface finishing device 1 can shorten the work period for a floor surface finishing operation up to one-seventh to one-tenth compared

to conventional construction methods.

[0053]

In the floor surface finishing device 1 of the present embodiment, an operator manually conducts up-and-down moving operations of the finishing blade 8 (moving  
5 operations in a direction including a moving direction in parallel to the pivotal center C of the rotary blades 4) and a horizontal rotating operation of the finishing blade 8 centering around the hook 11. Alternatively, these operations can be motorized by providing mechanisms powered by the motor 3 or by an electric motor with a battery as a power source, such as a hydraulic, gear, wire, link, belt, chain and cam mechanisms. With the  
10 mechanisms, physical load of an operator can be further alleviated.

[0054]

Next, with reference to Figs. 5 to 9, other embodiments of a finishing blade will be explained below. A finishing blade 8a shown in Fig. 5 is formed of a flexible elastic plate as in the above-described finishing blade 8 and has a substantially rectangular shape with all  
15 of the four corners made round. On a top surface of the finishing blade 8a, disposed is a fixing member 12a having a L-shaped section, and an auxiliary member 8e is disposed on a bottom surface of the finishing blade 8a, into which a plurality of screws 13a are screwed from a bottom side. Thus, the fixing member 12a and the finishing blade 8a are fixed. The finishing blade 8a, as in the finishing blade 8, can be attached to the floor surface  
20 finishing device 1 shown in Figs. 2 and 3 in use. In this case, the fixing member 12a located on the top surface of the finishing blade 8a is fixed to a mounting member 6i on the distal end of the elevating arm 6f of the floor surface finishing device 1 shown in Figs. 2 and 3 via a screw (not shown) in use. Since the finishing blade 8a is fixed to the fixing member 12a with the auxiliary member 8b and the screws 13a provided on the bottom  
25 surface of the fixing member 12a, the secure fixing state is further improved and the fixing

blade 8a has a strong resistance against deformation.

[0055]

A finishing blade 8b shown in Fig. 6 is formed of a flexible elastic plate and has a substantially rectangular shape with all of the four corners made round as in the above-described finishing blade 8a. On a top surface of the finishing blade 8b, firmly attached is a fixing member 12b having a reversed T-shaped section. In use, similar to the finishing blade 8a, the finishing blade 8b is fixed to the mounting member 6i on the distal end of the elevating arm 6f of the floor surface finishing device 1 shown in Figs. 2 and 3 via a screw (not shown). The fixing member 12b is firmly attached to the finishing blade 8b by fixing means such as spot welding, hot welding or an adhesive.

[0056]

On a surface of a finishing blade 8c shown in Fig. 7, firmly attached is a mounting member 8d having a substantially C-shaped section. A fixing member 12c having a T-shaped section is slid into a groove of the mounting member 8d along its longitudinal direction so that the fixing member 12c can be detachably fixed to the finishing blade 8c. The fixing member 12c comprises a connecting portion 12e which is inserted into the groove of the mounting member 8d in a posture to face the finishing blade 8c and a fixing portion 12d which is firmly attached on a top surface of the connecting portion 12e to form a rib. In use, the fixing member 12c is attached to the finishing blade 8c, and the fixing portion 12d of the fixing member 12c is fixed to the mounting member 6i on the distal end of the elevating arm 6f of the floor surface finishing device 1 shown in Figs. 2 and 3 with a screw (not shown). In this embodiment, the finishing blade 8c is detachable while the fixing member 12c is being attached to the floor surface finishing device 1, which accelerates operations for detaching and replacing the finishing blade 8c.

[0057]

When using a finishing blade 28 shown in Figs. 8 and 9, a fixing member 22 firmly attached on a surface thereof is fixed with a plurality of screws 23 to a mounting member 26i which is tiltably mounted on a distal end of an elevating arm 26f of a floor surface finishing device (not shown). A plurality of tubular bodies 26c firmly attached to an upper edge of the mounting member 26i are arranged so as to be coaxial to a plurality of tubular bodies 26m firmly attached to a distal end of the elevating arm 26f and a tubular body 26b firmly attached to a distal end of a plurality of reinforcing members 26a which extend from the elevating arm 26f. A shaft body 21 is inserted into these tubular bodies 26b, 26c and 26m so that the mounting member 26i is tiltably mounted centering around the shaft body 21 as shown in Fig. 9.

[0058]

Between a vicinity of a center of the upper edge of the mounting member 26i and a vicinity of the distal end of the elevating arm 26f, provided is a link mechanism 20 which comprises two connecting members 20a and 20c connected to each other by a hinge portion 20b. An end portion of the connecting member 20a is firmly fixed to the upper edge of the mounting member 26i. A connecting hole 26e of a U-shaped connecting portion 20d firmly attached to an end portion of the connecting member 20c is brought to correspond with one of a plurality of connecting holes 26k which are opened on a connecting member 26j firmly fixed to a vicinity of the distal end of the elevating arm 26f. Then, a pin 20e is inserted into the connecting holes 26e and 20e so that the mounting member 26i along with the finishing blade 28 and the other members are fixed to the elevating arm 26f.

[0059]

In this case, depending on the hole among the plurality of connecting holes 26k on the connecting member 26j selected to correspond with the connecting hole 26e of the connecting portion 26d on the end portion of the connecting member 20c, an angle of the

mounting member 26i mounted to the elevating arm 26f can be set. Thus, an angle of attack  $\theta$  of the finishing blade 28 to the floor surface to be finished 2a can be selectively set, thereby obtaining the optimal angle of attack  $\theta$  for each operating condition.

[0060]

5           Next, with reference to Figs. 10 to 12, floor surface finishing devices according to second to fourth embodiments of the present invention will be explained below. In components of floor surface finishing devices 30, 40 and 50 shown in Figs. 10 to 12, the components which have the same structures and functions as those of the above-mentioned floor surface finishing device 1 bear the same reference numerals as in Figs. 1 to 4 and the  
10       explanations are omitted.

[0061]

          In the floor surface finishing device 30 shown in Fig. 10, a vertical shaft 36a of a connecting member 36 is mounted on a hook 11 provided on a support 10 of a plane leveling machine 5. A tubular member 36b is fixed on an upper end of the vertical shaft  
15       36a so as to downwardly incline toward a front. An elevating arm 36f is slidably inserted inside the tubular member 36b. A wire 37 with its distal end portion fixed to the vertical shaft 36a extends through a pulley 30a provided on a distal end portion of the elevating arm 36f, a pulley 30b provided on an upper end portion of the tubular member 36b, a pulley 30c provided on an elevating lever 31 which can be tiltably operated, and a pulley 30d provided  
20       on an operating handle 9, to reach a pulley 30c and then fixed thereto.

[0062]

          When the elevating lever 31 is tilted, the wire 37 is let in and out, thereby sliding the elevating arm 36f upward and downward along a longitudinal direction of the tubular member 36b. In this manner, a finishing blade 8 can come into contact with or separate  
25       from a floor surface to be finished 2. In the case of the floor surface finishing device 30,

an elevating mechanism for the finishing blade 8 can be formed of the tubular member 36b and the elevating arm 36f, which simplifies structure of the device.

[0063]

In the floor surface finishing device 40 shown in Fig. 11, a vertical shaft 46a of a  
 5 connecting member 46 is mounted on a hook 11 provided on a support 10 of a plane  
 leveling machine 5. An elevating arm 46f is rotatably mounted, via a shaft 46g, on  
 auxiliary members 46b and 46c which are fixed to a lower end portion of the vertical shaft  
 46a. A pulley 40b is provided on an upper end of the vertical shaft 46a. A slanting shaft  
 46i obliquely extends downward from an upper end portion of the vertical shaft 46a, of  
 10 which distal end has a stopper 46h to define an elevated position of the elevating arm 46f.  
 A wire 47 with its distal end fixed to the vertical shaft 46a extends through a pulley 40a  
 provided on a distal end portion of the elevating arm 46f, a pulley 40b provided on an upper  
 end portion of the vertical shaft 46a, a pulley 40c provided on an elevating lever 41 which  
 can be tiltably operated, and a pulley 40d provided on an operating handle 9, to reach a  
 15 pulley 40c and then fixed thereto.

[0064]

When the elevating lever 41 is tilted, the wire 47 is let in and out, thereby rotating  
 the elevating arm 46f centering around the shaft 46g in a predetermined angle. In this  
 manner, a finishing blade 8 can come into contact with or separate from a floor surface to be  
 20 finished 2. In the case of the floor surface finishing device 40, the finishing blade 8 can be  
 lifted and lowered by rotation of the elevating arm 46f which is relatively short. Thus, the  
 elevating mechanism can be made compact. In addition, when the elevating arm 46f is  
 lifted up to be nearly vertical by largely tilting the elevating lever 41, the finishing blade 8  
 as well as a plumb bob 15 can be housed on a side of the plane leveling machine 5. In this  
 25 case, the plumb bob 15 approaches a center of gravity of the plane leveling machine 5,



which prevents decline of operability when only the function of the plane leveling machine 5 is used for operation.

[0065]

Next, in the floor surface finishing device 50 shown in Fig. 12, a vertical shaft 56a is mounted on a hook 11 on a support of a plane leveling machine 5, and a base end portion of an elevating arm 56f is rotatably pivoted on a shaft 56g provided on a portion close to a lower end of the vertical shaft 56a. A base end portion of an auxiliary elevating arm 56d is rotatably pivoted on a shaft 56c provided on a distal end of a horizontal shaft 56b which extends from an upper end of the vertical shaft 56a frontward. A pulley 50a is disposed on a distal end portion of the elevating arm 56f, a pulley 50b disposed on a distal end portion of the auxiliary elevating arm 56d, a pulley 50c disposed on an elevating lever 51a, and a pulley 50d disposed on an operating handle 9.

[0066]

A wire 57a with its distal end portion fixed on a top surface of the distal end portion of the auxiliary elevating arm 56d extends through the pulley 50c and the pulley 50d and is fixed to the pulley 50c. A wire 57b with its distal end portion fixed on a bottom surface of the auxiliary elevating arm extends through the pulley 50a and the pulley 50b and is fixed to an auxiliary elevating lever 51b.

[0067]

When the elevating lever 51a is tilted, the wire 57a is let in and out, thereby rotating the auxiliary elevating arm 56d centering around the shaft 56c. At this time, the elevating arm 56f rotates centering around the shaft 56 in a relatively large motion via the wire 57b in a state of being stretched between the pulleys 50a and 50b. Therefore, a finishing blade 8, a plumb bob 15 and other members can be lifted and lowered within a relatively wide range of height. On the other hand, when the auxiliary elevating lever 51b

is tilted, the wire 57b is let in and out, thereby rotating the elevating arm 56f centering around the shaft 56g within a relatively narrow range so that the finishing blade 8 can come into contact with and separate from a floor surface to be finished 2.

[0068]

5 Accordingly, during floor finishing operations, the auxiliary elevating lever 51b is manipulated to make the finishing blade 8 come into contact with and separate from the floor surface to be finished 2. After completing the floor finishing operations, the elevating lever 51a is manipulated to highly lift up the finishing blade 8, the plumb bob 15, and other members. In this manner, in the floor surface finishing device 50, by tilting  
10 operations of each of the elevating lever 51a and the auxiliary elevating lever 51b which are disposed at the hands of an operator standing at a position of the operating handle 9, the finishing blade 8 can be moved in lifting and lowering directions, which leads to easy manipulation and excellent operability.

[0069]

15 Next, with reference to Figs. 13 to 16, floor surface finishing devices according to fifth to seventh embodiments of the present invention will be explained below. In components of floor surface finishing devices 60, 70 and 80 shown in Figs. 13 to 16, the components which have the same structures and functions as those of the above-mentioned floor surface finishing device 1 bear the same reference numerals as in Figs. 1 to 12 and the  
20 explanations are omitted.

[0070]

The floor surface finishing device 60 shown in Figs. 13 and 14 comprises a plane leveling machine 165 having rotary blades 4 disposed at two positions on right and left which are driven by a motor 63, a finishing blade 68 connected to the plane leveling  
25 machine 165 via an elevating arm 65, and seat S on which an operator sits. The elevation

arm 65 is rotatably pivoted on a shaft 64. A pulley 67 is disposed on a portion close to a distal end of the elevating arm 65, and a pulley 69 is disposed on an upper end portion of a vertical shaft 62 standing on a base end portion of the elevating arm 65. A wire 66 with its distal end portion fixed on the vertical shaft 62 extends through a pulley 67 and a pulley 69 and is fixed to a hoist 61 which is electrically driven. An operator sits on the seat S and manipulates two operating handles H to move the plane leveling machine 165 backward and forward and from side to side or to change the direction.

[0071]

While rotating the rotary blades 4 of the plane leveling machine 165, with a part of the finishing blade 68 coming into contact with a floor surface to be finished 2, an operator sitting on the seat S moves the floor surface finishing device 60 forward (toward a left side in Fig. 13), thereby conducting a floor surface finishing operation by a similar action to that of the above-described floor surface finishing device 1. As the operator can conduct the operation while sitting on the seat S, his/her physical load can be alleviated. Furthermore, the finishing blade 68 can be lifted and lowered by activating the electrically-driven hoist 61 with a predetermined operating switch (not shown), which improves operability. In addition, the floor surface finishing device 60 is provided with the finishing blade 68 which has a larger longitudinal size compared to the above-described floor surface finishing device 1, enabling a finishing operation over a large area of the floor surface to be finished 2, which considerably promotes efficiency of the operation.

[0072]

Next, in the floor surface finishing device 70 shown in Fig. 15, an elevating arm 74 is slidably inserted inside a tubular member 73 which is fixed slantwise to a distal end of a horizontal shaft 79 extending from a rear portion of the plane leveling machine 165. A finishing blade 75 is attached to a distal end portion of the elevating arm 74. A pulley 76 is

disposed at a portion close to the distal end portion of the elevating arm 74, and a pulley 77 is disposed on an upper end portion of the tubular member 73. A wire 78 with its distal end portion fixed on the horizontal shaft 79 extends through the pulley 76 and the pulley 77 and is fixed to a hoist 61 which is electrically driven. An operating method for the floor surface finishing device 70 is similar to the method for the above-described floor surface finishing device 60. On the other hand, in the floor surface finishing device 70, an elevating mechanism of the finishing blade 75 can be formed of the tubular member 73 and the elevating arm 74, which simplifies the structure.

[0073]

Next, in the floor surface finishing device 80 shown in Fig. 16, an elevating arm 83 is rotatably pivoted on a shaft 82 provided on a distal end of a slanted shaft 81 which is fixed slantwise to a vertical shaft 88 standing on a rear portion of the plane leveling machine 165. A finishing blade 84 is attached to a distal end portion of the elevating arm 83. A pulley 87 is disposed at a portion close to the distal end portion of the elevating arm 83, and a pulley 86 is disposed at an upper end portion of the vertical shaft 88. A wire 85 with its distal end portion fixed on the vertical shaft 86 extends through the pulley 87 and the pulley 86 and is mounted on a hoist 61 which is electrically driven. The floor surface finishing device 80 exhibits the effect similar to that of the above-described floor surface finishing device 60.

[0074]

The place where the electrically-driven hoist 61 used in the floor surface finishing devices 60, 70 and 80 is installed is not limited to the positions shown in Figs. 13 to 16 but can be varied depending on use conditions and operating situations.

[0075]

In the floor surface finishing devices 1, 30, 40, 50, 60, 70 and 80, a wire is used as

a mechanism for lifting and lowering a finishing blade, and a human power or an electric motor is used as a driving power thereof. However, the present invention is not limited to these members. The mechanism for lifting and lowering a finishing blade can be composed of an air cylinder activated by an electric motor or a motor, a link mechanism  
5 using a hydraulic cylinder, a belt mechanism, a chain mechanism, a cam mechanism, or the like, and the elevation of the finishing blade and the adjustment of an angle of attack can be conducted with a switching operation. When employing an air cylinder, a hydraulic cylinder, or the like, the finishing blade can not only be moved upward and downward but also be maintained at a predetermined position and with a predetermined angle of attack.  
10 Therefore, it is also possible to omit a plumb bob which is used as a pressing means against a floor surface to be finished.

[0076]

Next, with reference to Figs. 17 and 18, floor surface finishing devices according to eighth and ninth embodiments of the present invention will be explained below. In the  
15 components of floor surface finishing devices 90 and 100 shown in Figs. 17 and 18, the components which have the same structures and functions as those of the above-mentioned floor surface finishing device 1 and the like bear the same reference numerals as in Figs. 1 to 12 and the explanations are omitted.

[0077]

20 In the floor surface finishing device 90 shown in Fig. 17, by tilting an elevating lever 91a, an elevating arm 96f is rotated within a relatively small range centering around a shaft 96g via a wire 97a, thereby lifting and lowering a finishing blade 8. By tilting an auxiliary elevating lever 91b, the elevating arm 96f is rotated within a relatively large range centering around the shaft 96g. Thus, as shown in an imaginary line in Fig. 17, the  
25 finishing blade 8 can be lifted in a nearly vertical position and housed on a side of a plane

leveling machine 5. At this time, a plumb bob 15 is also positioned closely to a center of gravity of the plane leveling machine 5, which prevents decline of operability when only the function of the plane leveling machine 5 is used for a floor leveling operation.

[0078]

5 Closely to a distal end of the elevating arm 96f, an angle adjusting lever 92a, as well as the finishing blade 8, which rotates centering around a shaft 93 and a mounting member 92b which defines a holding position of the angle adjusting lever 92a are provided. Thus, by changing the holding position of the angle adjusting lever 92a in relation to the mounting member 92b, an angle of attack  $\theta$  of the finishing blade 8 can be varied.

10 [0079]

Next, in the surface finishing device 100 shown in Fig. 18, when an operator manipulates a switch 101 disposed on an operating handle 9, an electrically-driven hoist 61 disposed on a support 10 of a plane leveling machine 5 is activated to wind up or reel out a wire 107. In this manner, an elevating arm 106f rotates centering around a shaft 106g, thereby lifting and lowering a finishing blade 8 and a plumb bob 15. An operator can move the finishing blade 8 up and down simply by manipulating the switch 101 at his/her hands, which leads to good operability and reduced physical load. The position where the electrically-driven hoist 61 is installed is not limited only to the position on the support 10 but can be appropriately selected depending on using conditions and operating situations.

## 20 INDUSTRIAL APPLICABILITY

[0080]

The floor surface finishing device in the present invention can be widely used in an industrial field where finishing operations of concrete floor surfaces or mortar floor surfaces are conducted.